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Adherence to a Dash-style diet in relation to depression and aggression in adolescent girls

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ABSTRACT

The aim of this study was to assess adherence to the Dietary Approach to Stop Hypertension (DASH) dietary pattern in relation to depression and aggression in adolescent girls. The study was carried out among 580 girls aged between 12 and 18 years of age. DASH scores were determined according to the method of Fung et al. A Persian version of the Beck Depression Inventory and Buss-Perry questionnaire were used for the assessment of depression and aggression. We analysed our data using crude and adjusted models. Adjustments were made for age, energy intake, mother's job status, passive smoking, start of menstruation, parental death, parental divorce, physical activity level and body mass index, using three different models. A high adherence to a Dash-style diet (for individuals in the upper quartile) was associated with a lower odds of depression compared with subjects with lower adherence (those in the lowest quartile) (OR 0.47; 95% CI 0.26–0.84, P-value = 0.009); these associations remained significant after adjustments. However, we did not obtain any significant relationship between a DASH-style diet and aggression. We observed a significant inverse relationship between greater adherence to a DASH diet and lower odds of depression. Further prospective studies are needed to confirm these findings.

1. Introduction

Recent reports indicate that mental health disorders and substance misuse are an important cause of disability adjusted life years and the leading cause of all non-fatal diseases globally (Whiteford et al., 2013). Depression is one of the most common mental health conditions (Meyer, 2004; Üstün et al., 2004). It is a heterogeneous disorder with behavioural, psychological, and somatic symptoms (Joynt et al., 2003). Depression has a lifetime prevalence approaching 17%, and is likely to become the second largest disease burden globally by 2020 (Whiteford et al., 2013). In Iran, it has been reported that 43.5% of the adolescent population is afflicted with depression (Sajjadi et al., 2013). Aggression is a behaviour which is characterised by violent and agonistic behaviour (Gorman et al., 1998). Aggression and violence have several adverse outcomes. Violent behaviour has been proposed to be in the top 20 causes of disability adjusted life years and predicted to increase by 2030 (Rutherford et al., 2007). In a recent systematic review, the prevalence of aggression was reported to be between 40% and 89% in Iranian adolescents and youth (Sadeghi et al., 2014). The prevention and management of these psychological disorders would be of considerable importance.

Several life style factors, including diet, are thought to contribute to

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these psychological disorders (Sacks et al., 2001). Studies have previously assessed the association between several nutrients and foods and psychological disorders. It has been reported that dietary intakes of fish, n-3 poly unsaturated fatty acids (PUFAs), folate, and B vitamins may prevent depressive symptoms (Murakami and Sasaki, 2010). A direct relationship was reported between "junk food" consumption and risk of violent behaviour in Iranian children and adolescents (Zahedi et al., 2014); while Amelia et al. have suggested that a healthy lifestyle is related to a reduced risk of violence in adolescents. A healthy life style includes good nutrition, hygiene practices and being physically active (Turagabeci et al., 2008).

Nutritional epidemiologists have stressed the importance of using an overall dietary pattern approach, rather than individual nutrients or foods, to investigate diet–disease relationships. Using this approach would allow a reduction in the co-linearity confounding that may result when assessing foods and nutrients intake (Hu, 2002). Although, some studies have evaluated the association between various dietary patterns and depression status (Lai et al., 2014), there appear to be no studies on their relationship with aggression.

Findings from a meta-analyses have indicated that adherence to a healthy pattern with high intakes of vegetables, whole grains, fruit and fish, may be related to a reduction in depression risk (Lai et al., 2014). The Dietary Approaches to Stop Hypertension (DASH) pattern is an a priori healthy pattern that contains high intakes of whole grains, fruits, vegetables, legumes and nuts; moderate amounts of low-fat dairy; low amounts of red or processed meats, desserts, and sweetened beverages, and was originally designed to reduce blood pressure (Sacks et al., 2001). Although the beneficial effects of DASH-style diet on other metabolic conditions such as metabolic syndrome (Azadbakht et al., 2011), and cardiovascular disease (Salehi-Abargouei et al., 2013) have been reported, there are limited data available on the association of DASH-style diet and psychological disorders especially in children and adolescents. To the best of our knowledge only a handful of studies have been undertaken between adherence to DASH-style diet and risk of psychological disorders (Torres and Nowson, 2012; Valipour et al., 2015). In one randomized controlled clinical trial, it was concluded that in postmenopausal women, a moderate-sodium DASH-style diet with the consumption of lean red meat on most days, improved mood and depression (Torres and Nowson, 2012). Valipour et al. (2015) reported an inverse association between higher adherence to DASH dietary pattern and depression prevalence among general public adults. Given the potential importance of DASH-style diet in health and high prevalence of psychological disorders, we conducted a cross-sectional study to assess the relationship between adherence to DASH-style diet and depression and aggression presence in 535 adolescent girls.

2. Methods and materials

2.1. Study population

The current cross-sectional study was carried out during 2015, within a sample of adolescent girls living in Iran, that aimed to investigate the association between adherence to DASH dietary pattern and risk of depression and aggression. Participants were recruited using a stratified-cluster random sampling method. The total population included 535 girls aged between 12 and 18 years. We excluded those with any autoimmune diseases, cancer, metabolic bone disease, hepatic or renal failure, cardiovascular disorders, malabsorption or thyroid, parathyroid, adrenal diseases and anorexia nervosa or bulimia. In addition, individuals with taking anti-inflammatory, anti-depressant, anti-diabetic, or anti-obesity drugs, vitamin D or calcium supplement use and hormone therapy within the last 6 months were not included. All study participants completed written informed consent forms prior to study enrolment. The Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, approved this study.

2.2. Demographic and anthropometric assessments

General demographic and socioeconomic data were collected by trained interviewers. Family socioeconomic status (SES) was collected using a standard questionnaire that was previously approved in the Progress in the International Reading Literacy Study (PIRLS) for Iran (Martin et al., 2007). The questionnaire including some variables such as parents' job, possessing private car, school type (public/private), parents' education, type of home (private/rental). SES score was categorized into tertiles, in which the first tertile was defined as low, second tertile as moderate, and third tertile as high SES.

In our study, the majority of mothers were housewife. All of the employed mothers had a full-time job. Therefore, we divided mother job status to just two categories: employed and housewife. Also, educational level of our participants was categorized into middle and high school levels.

Physical activity information was obtained by using the validated Modifiable Activity Questionnaire (MAQ) (Delshad et al., 2015). The participants reported their physical activity over the past year. Specifying the frequency, duration, and thus intensity was determined for physical activity. Physical activity level was calculated based on metabolic equivalent task minutes per week (1 MET = 3.5 mL kg^{-1} min^{-1} of O_2 consumption).

Weight, height and waist circumference were measured using standard protocols. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared.

2.3. Dietary assessment

A 168-item food frequency questionnaire was used assess dietary intakes. The assessment of the validity and reliability of this has been previously reported (Asghari et al., 2012; Hosseini Esfahani et al., 2010). The questionnaire was completed by face-to-face interview. To estimate energy and nutrient intakes, the reported portion size in food frequency questionnaire was converted to grams using household measures and then was entered to the Nutritionist IV software. We assessed under or, over reporting in our population and individuals with an under, or over-reported energy intake (n = 20) were excluded. These subjects reported an energy intake to estimated energy requirement ratio outside the ± 3 SD limits (Table, 2005). The effect of energy intake was controlled by calculating the food group intakes per 1000 Kcal.

2.4. Adherence to Dash-style diet

DASH scores were determined according to the method of Fung et al. (2008). The DASH score includes a measure of high intake of nuts and legumes, fruit, vegetables and low-fat dairy products and whole grains according to quintile categories (i.e., lowest quintile is considered 1 point and highest quintile is considered 5 points). Participants with lower quintile of intake of sweetened beverages, sodium, and red and processed meats were assigned higher points (i.e., the highest quintile received a score of 5 and the lowest quintile received a score of 1). Finally, all component scores were integrated to obtain the overall DASH score, ranging from 8 to 40 points.

2.5. Assessment of psychological health

A Persian version of the Beck Depression Inventory (BDI) was used for the assessment of depression in the current study. The BDI is a self-administered questionnaire of 21 items with various options. The score for the BDI ranges between 0 and 63 points. If the BDI score was < 16, the person was considered as not depressed, and if the subject's score was > 16, they were categorized as depressed. The validity and reliability of BDI were assessed in previous studies (Cronbach's α = 0.87 and acceptable test-retest reliability (r) = 0.74) (Ghassemzadeh et al.,

2005)

A validated Persian version of Buss-Perry questionnaire was used for the assessment of aggression score (Rahman et al., 2012). This questionnaire includes 29 questions in a multiple choice-format. We used a median cut-point for the definition of aggression; therefore, the subjects were categorized as aggressive if their score was > 64.

2.6. Statistical methods

Participants were categorized into quartiles of their total DASH-style diet scores. Linear regression and χ^2 analyses were used to examine the significant differences of continuous (including age, BMI, weight, metabolic equivalent task and waist circumference) and categorical (including passive smoking, menstruation, parent death, parent divorce, mother job status, socioeconomic level and educational stage) variables, respectively, across the quartiles of DASH score. Energy-adjusted dietary intakes of study participants were compared by linear regression across quartiles of DASH score. We used multivariable logistic regression in several models for investigating the association between DASH-style diet with depression and aggression. In adjusted models, we controlled for age and energy intake in Model I. Further adjustments were performed for maternal occupation status, passive smoking, menstruation, parental mortality and parental divorce in Model II. Finally, additional adjustments were made for physical activity, BMI socioeconomic level and education stage in last Model. All statistical analyses were performed using the SPSS v 18.0 (SPSS Corp, version 18, Chicago, IL, USA). P values < 0.05 were defined as statistically significant.

3. Results

Of the 535, 32.0% of study participants were depressed (n = 172) and 28.1% had a high aggression score (n = 152). General characteristics of the study participants across categories of DASH score are shown in Table 1. Subjects with higher DASH scores were slightly younger (P-value = 0.005). No other significant differences were seen in general characteristics of study participants across categories of DASH score (all P-value > 0.05).

As can be seen from Table 2, individuals with the greatest adherence to the DASH-style diet, as would be expected, had higher intakes of fruits, vegetables, nuts, legume, seed, low fat dairy products, whole grain, and fish, and lower consumption of red and processed meat, sweetened beverage, sodium and refined grains. Moreover, consumption of a DASH-style diet was associated with higher intakes of energy, carbohydrate, dietary fiber, vitamin C, folate, vitamin A, vitamin D, calcium, magnesium and potassium, and lower intakes of total fat, mono-unsaturated fatty acid and PUFA.

Multivariable-adjusted odds ratios for depression and aggression across categories of DASH-style diet are presented in crude and adjusted models in Table 3. In first model, odds ratio was adjusted for age and energy intake. Further adjustments were made for maternal job status, passive smoking, menstruation, parental death, and parental divorce. Finally, in the last model, we additionally controlled these associations for BMI, physical activity, socioeconomic status and education level. Using an unadjusted model, the odds of depression decreased with increasing adherence to a DASH-style diet (OR 0.47; 95% CI 0.26–0.84, P-value = 0.009); after controlling for potential confounders, the findings remained significant in all three adjusted models.

We did not find any significant association between adherence to DASH-style diet and aggression in the crude model (OR 0.85; 95% CI 0.48–1.51, P-value = 0.6); and these associations did not change after adjustments.

In addition, we applied principal component analyses to explore major dietary patterns among adolescent girls. Although three major dietary patterns were extracted, but we found no significant associations between these dietary patterns and the presence of depression or aggression.

4. Discussion

Our findings from the current study indicated that a high adherence to DASH-style diet was related to lower odds of depression in adolescent girls. However, we failed to observe any associations between DASH-style diet and aggression score. To the best of our knowledge, this is the first study that has evaluated the association between adherence to DASH-style diet and psychological disorders in adolescents. Moreover,

Table 1
General characteristics of study participants by quartiles of DASH-diet style.[a]

	Quartiles of DASH score (ranged from 0 to 40)				
	Q1	Q2	Q3	Q4	*P* value[b]
N	158	140	137	100	
Age (y)	14.8 ± 1.5	14.7 ± 1.5	14.4 ± 1.5	14.1 ± 1.6	0.005
BMI (Kg/m^2)	21.1 ± 3.6	20.9 ± 3.6	21.5 ± 4.04	21.9 ± 4.1	0.16
Weight (Kg)	52.3 ± 10.3	51.9 ± 10.03	53.3 ± 11.4	54.9 ± 12.1	0.16
Metabolic equivalent task (h/day)	6.4 ± 0.51	6.4 ± 0.38	6.4 ± 0.52	6.4 ± 0.51	0.89
Waist circumference (cm)	70.2 ± 8.1	69.9 ± 8.1	71.4 ± 9.4	72 ± 8.6	0.2
Aggression score	78.7 ± 19.2	77.7 ± 21.07	74.2 ± 17.6	75.9 ± 19	0.09
Depression score	11.6 ± 8.18	10.7 ± 7.89	9.4 ± 7.35	8.67 ± 7.14	0.01
Mother job status					
Employed	9.4	17.9	11.2	15.3	0.14
Housewife	90.6	82.1	88.8	84.7	
Educational stage					
Middle school	59.9	57.7	55.3	51.8	0.22
High school	40.1	42.3	44.7	48.2	
Socioeconomic level					
High	23	24	23	25	0.37
Moderate	60	61	58	60	
Low	17	15	19	15	
Passive smoker (%)	26.4	20.9	23.5	15.5	0.23
Menstruation (%)	90.5	90.7	86.9	81	0.2
Parent death (%)	5.1	3.6	3.6	4	0.99
Parent divorce (%)	7	5.7	3.6	3	0.81

[a] Values are means ± SDs or n (%).
[b] Obtained from linear regression or χ^2 analyses for continuous and categorical variables, respectively, according to quartiles of DASH diet score.

Table 2
Dietary intakes of study participants according to quartiles of DASH-diet style.[a]

	Quartiles of DASH score (ranged from 0 to 40)				
	Q1	Q2	Q3	Q4	*P* value[b]
Components of DASH-diet style (Median)	20	0.57 ± 0.45	0.81 ± 0.57	29	
Fruits (serving/1000 Kcal)	0.48 ± 0.38	0.73 ± 0.57	0.76 ± 0.44	0.8 ± 0.42	< 0.001
Vegetables (serving/1000 Kcal)	0.57 ± 0.35	0.47 ± 0.52	0.55 ± 0.56	0.94 ± 0.48	< 0.001
Nuts, legume, seed (serving/1000 Kcal)	0.32 ± 0.44	0.34 ± 0.27	0.4 ± 0.25	0.59 ± 0.58	< 0.001
Low fat dairy (serving/1000 Kcal)	0.23 ± 0.24	2.5 ± 2.2	2.9 ± 2.04	0.44 ± 0.29	< 0.001
Whole grain (serving/1000 Kcal)	2.2 ± 2.2	0.28 ± 0.31	0.23 ± 0.23	3.5 ± 2.08	< 0.001
Red and processed meat (serving/1000 Kcal)	0.32 ± 0.22	0.14 ± 0.21	0.12 ± 0.19	0.14 ± 0.09	< 0.001
Sweetened beverage (serving/1000 Kcal)	0.17 ± 0.21	1515 ± 449	1493 ± 516	0.04 ± 0.06	< 0.001
Sodium (milligram/1000 Kcal)	1692 ± 539	2.3 ± 2.6	2.9 ± 4.03	1420 ± 332	< 0.001
Fish (g/1000 Kcal)	2.8 ± 3.3	1.07 ± 1.21	0.96 ± 1.2	4.1 ± 5.2	0.01
Spices (g/1000 Kcal)	1.17 ± 1.15	8.2 ± 8.7	7.4 ± 6.2	0.79 ± 0.78	0.007
Eggs (g/1000 Kcal)	7.2 ± 7.7	114.3 ± 67.7	105.6 ± 55.4	7.8 ± 5.9	0.28
Refined grains (g/1000 Kcal)	125.6 ± 68.4	0.57 ± 0.45	0.81 ± 0.57	98.7 ± 47.6	< 0.001
Dietary nutrient intakes					
Total energy (Kcal)	2537 ± 681	2563 ± 659	2681 ± 658	2672 ± 766	0.04
Protein (%)	12.8 ± 2.4	13.4 ± 2.2	13.8 ± 1.9	14.7 ± 2.1	0.05
Carbohydrate (%)	52.7 ± 7.9	54.3 ± 7.6	55.5 ± 6.7	57 ± 6.7	0.04
Total fat (%)	36.2 ± 8.8	34.3 ± 8	33 ± 6.6	31 ± 7	< 0.001
Saturated fatty acid (%)	10.3 ± 3.07	10.2 ± 2.9	10.2 ± 2.9	9.5 ± 3.2	0.08
Monounsaturated fatty acid (%)	11.8 ± 3.8	11.2 ± 3.2	10.7 ± 2.8	9.7 ± 2.5	< 0.001
Polyunsaturated fatty acid (%)	8.4 ± 3.4	7.7 ± 2.9	7.2 ± 2.5	6.6 ± 2.3	< 0.001
Sucrose (g/1000 Kcal)	8.5 ± 5.6	9.08 ± 6.4	8.3 ± 4.1	7.9 ± 4.9	0.22
Dietary fiber (g/1000 Kcal)	15.8 ± 6.4	16.7 ± 6.5	16.2 ± 5.1	18.2 ± 5.2	0.009
Vitamin C (mg/1000 Kcal)	28.7 ± 14.4	34.3 ± 22.6	40.2 ± 23.6	41.6 ± 23.5	< 0.001
Folate (mcg/1000 Kcal)	221.3 ± 48.3	229.9 ± 53.9	225.6 ± 42.7	244.6 ± 48.3	0.002
Vitamin A (mcg/1000 Kcal)	184.5 ± 84.5	213.1 ± 120.1	220.5 ± 95.7	258.1 ± 119.1	< 0.001
Vitamin D (mcg/1000 Kcal)	0.74 ± 0.63	0.82 ± 0.67	0.83 ± 0.51	1.06 ± 0.77	< 0.001
Potassium (mg/1000 Kcal)	1242 ± 242	1362 ± 273	1439 ± 265	1539 ± 252.5	< 0.001
Calcium (mg/1000 Kcal)	380.3 ± 130.1	428.6 ± 141.9	453.6 ± 125.5	477.6 ± 141.5	< 0.001
Magnesium (mg/1000 Kcal)	158.7 ± 39.6	177.3 ± 36.3	191.4 ± 34.8	211.9 ± 34.4	< 0.001

[a] Values are means ± SDs or n (%).
[b] Obtained from linear regression according to quartiles of DASH score.

Table 3
Multivariable-adjusted odds ratio of the associations between depression, Aggression and DASH-diet style.

	Quartiles of DASH score (ranged from 0 to 40)				
	Q1	Q2	Q3	Q4	*P* value[a]
Depression					
Crude	1.00	0.87 (0.54–1.41)	0.74 (0.43–1.16)	0.47 (0.26–0.84)	0.009
Model I	1.00	0.88 (0.54–1.42)	0.71 (0.43–1.16)	0.47 (0.26–0.85)	0.01
Model II	1.00	0.8 (0.47–1.36)	0.73 (0.42–1.25)	0.48 (0.25–0.91)	0.02
Model III	1.00	0.79 (0.46–1.33)	0.68 (0.37–1.2)	0.47 (0.23–0.92)	0.03
Aggression					
Crude	1.00	0.79 (0.47–1.32)	0.84 (0.5–1.41)	0.85 (0.48–1.51)	0.6
Model I	1.00	0.78 (0.46–1.3)	0.83 (0.49–1.4)	0.87 (0.49–1.56)	0.64
Model II	1.00	0.72 (0.41–1.27)	0.74 (0.42–1.31)	0.83 (0.44–1.56)	0.52
Model III	1.00	0.75 (0.42–1.31)	0.79 (0.46–1.33)	0.87 (0.45–1.59)	0.49

Model 1: Adjusted for age and energy intake. Model 2: additionally, adjusted for mother job status, passive smoker, menstruation, parent death and parent divorce. Model 3: further adjustments for physical activity, BMI, socioeconomic level and education stage.
[a] Obtained from linear regression according to quartiles of DASH score.

we did not find any reports that examined the relationship between dietary pattern and aggression status.

Depression is one of the most common mental health conditions that its symptoms are related to increased risk of chronic diseases (Anderson et al., 2001; Joynt et al., 2003) and mortality (Cuijpers et al., 2014). Nutrition and life style related modifications were considered as one of the proposed approaches to prevent depression (Khalid et al., 2016). Valipour et al. evaluated the association between adherence to DASH-style diet and psychological health among Iranian adults and reported an inverse association between more adherence to DASH dietary pattern and depression (Valipour et al., 2015). However, they failed to find a linear relationship between DASH-style diet and depression, and the inverse association was only seen with moderate adherence. In a systematic review and meta-analysis, Lai et al. (2014) reported that consumption of healthy dietary pattern, characterised by high intake of fruits, vegetables, whole grains, poultry, fish and reduced-fat dairy products was associated with reduced risk of depression; these findings were confirmed by a recent study in a Chinese population sample, and indicated the health dietary pattern is negatively related with the prevalence of high depressive symptoms (Xia et al., 2016); Also, higher intakes of fruits and vegetables were associated with decreased risk of depression among Australian and Chinese adolescents (Jacka et al., 2010). Tangney et al. have reported that both the DASH and Mediterranean diet patterns are associated with slower rates of cognitive decline in older persons (Tangney et al., 2014). In contrast, findings from a case-control study among Korean adolescent girls suggested consumption of fast food diet associated to higher risk of depression (Kim et al., 2015). Moreover, an observational study from 8 countries showed that sugar intake was related to depression because higher intake of sugar might increase oxidative stress (Westover and Marangell, 2002).

We did not observe any relationship between adherence to DASH-style diet and the presence of a high aggression score. This could be because of the type of questionnaire that was used for screening for aggression. We failed to find any study that examined the relationship between adherence to any dietary pattern and aggression. The association between food items and violence was evaluated in some previous

studies (Neumark-Sztainer et al., 1997; Zahedi et al., 2014). In a sample of 13486 Iranian children and adolescents, increased risk of violent behaviours was related to consumption of "junk foods" (Zahedi et al., 2014). It has also been reported that adherence to prudent diet (high consumption of salty snacks, sweets and cakes) are associated with risk of violence (Neumark-Sztainer et al., 1997), whereas healthy diet have beneficial effects on mental health (Brooks et al., 2002). Very limited data are available for the relation between diet and aggression status and therefore more prospective studies are required to asseess this association.

Several potential mechanisms for a relationship between diet and aggression have been proposed and discussed in previous studies. The exact mechanisms for the effects of a DASH diet on psychological health are still unclear. The potential role of inflammation and oxidative stress in the pathogenesis of depression (Howren et al., 2009; Maes et al., 2011) may suggest advantageous impacts of DASH diet. The effects of this diet on inflammatory cytokines might be related to its high content of antioxidant-rich fruits and vegetables. Another possible mechanism for the beneficial effects of DASH is related to the role of a DASH-style diet in improvement of metabolic syndrome and its components (Azadbakht et al., 2011; Hajna et al., 2012); considering that the presence of metabolic syndrome increased the risk of psychological disorders (Roohafza et al., 2012; Viinamäki et al., 2009).

This is the first study that has examined the relationship between a DASH- style diet and psychological disorder in adolescents. Taking a wide range of potential confounders into account is a potential strength of our study. Furthermore, data collection was done with high quality control.

The cross-sectional design of this work is possibly the major limitation as it makes us unable to ascertain causality. Furthermore, relatively low sample size of our study is considered as a potential limitation. In future studies male gender should be also included.

5. Conclusion

In summary, a diet that resembles the DASH style-diet, with high intake of whole grains, fruits and vegetables; moderate intake of legumes, nuts, and low-fat dairy products; and low intake of red and processed meats and sodium, was associated with lower risk of depression. Given the high prevalence of depression and based on the findings of the current study, we believe that a DASH diet could be considered as a possible means of preventing or managing depressive disorders. Further larger sample size studies, with the inclusion of both male and female subjects, and possibly intervention studies are required.

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Conflict of interest statement

The authors have no conflict of interest to disclose.

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